AN EVALUATION OF RESULTS OF MUSCLE PEDICLE BONE GRAFTING IN FRESH AND UN-UNITED INTRACAPSULAR FRACTURE NECK FEMUR

MASTER OF SURGERY
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C E R T I F I C A T E

Certified that this thesis entitled " AN EVALUATION OF RESULTS OF MUSCLE PEDICLE BONE GRAFTING WITH CANNULATED SCREWS FIXATION IN FRESH AND UNUNITED INTRACAPSULAR FRACTURE NECK FEMUR" is the bonafide work of Dr. Avadesh Kumar, and was conducted in this department.

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C E R T I F I C A T E

This is to certify that the work entitled " AN EVALUATION OF RESULTS OF MUSCLE PEDICLE BONE GRAFTING IN FRESH AND UNUNITED INTRACAPSULAR FRACTURE NECK FEMUR", which is being submitted as a thesis for M.S.(Orthopaedic Surgery) was carried out by Dr. Avadesh Kumar, under my constant supervision and guidance in this department.

The technique embodied in this work were undertaken by the candidate himself. The observations and results were checked and verified by me periodically.

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I feel proud of my respected parents who have been incessant source of blessing and encouragement, which keep me going. It is by their grace that I am able to fulfil and shall be able to rise further in my life. Blessing and love from my respected elder brother Mr. Arvind Kumar was a constant source of inspiration while at work far away from him even he was patient of paraplegia.

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(AVADESH KUMAR)

Dated : 31/3/90

C O N T E N T S

INTRODUCTION

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The fractures of femoral neck have always presented great challenge to orthopaedic surgeons and still remain unsolved fracture as far as treatment and results are concerned. For more than a century, its treatment and results have been a matter of controversy and inquiry among surgeons. Although the results obtained today show improvement, but they are not comparable to other fractures due to its peculiar structural anatomy and biomechanical differences.

Generally femoral neck fractures are seen in geriatric age group, mainly in post-menopausal elderly females. But due to advancement of industry and fast road traffic on road increased. This fracture is also increasing in adults, teenage population. In old age trivial trauma is sufficient to cause fracture neck femur due to osteoporosis. But in adults and young population heavy trauma like fall from height, road traffic accidents.

Various characteristics of femoral neck fracture are producing difficulties in its management.

1. Neck shaft angle - Weight transmission from pelvis to femur is not an axial but it is angular. So shear force in neck of femur is heavy. To keep proximal

fragment in apposition with distal fragment requires very rigid fixation.

2. Vascularity - Vascular supply of head is notorious, runs from metaphysial area to head. When femoral neck get fractured and displaced, the vascular supply get interrupted and remaining blood vessels circulation hampered due to external rotation deformity and temponad of capsule.

3. Periosteum - Periosteum around the femoral neck is lack of combium layer which have osteoblastic activity in healing of fracture.

4. Synovial fluid - Synovial fluid has angiogenic inhibiting factor which inhibit the formation of fracture haematoma, thus hampering the healing of fracture.

5. Osteogenic activity is reduced in geriatric age group patient.

Various treatment modalities are available for fracture neck femur and having own merits and demerits.

1. Osteotomies around lesser trochanter,
2. Hanging Hip operation,
3. Arthrodesis,
4. Prosthetic replacement,
5. Total hip arthroplasty,
6. Osteosynthesis.

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AIMS OF STUDY

Aims of Treatment

To achieve union of fracture neck femur in its anatomical or near anatomical position.

Aims of Study

1. To evaluate the results of muscle pedicle bone grafting with cannulated screw fixation in case of fracture neck femur.
2. Assessment of complication of cannulated screw fixation and muscle pedicle bone grafting in fracture neck femur.
3. Assessment of functional, anatomical and radiological results and their correlation.

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REVIEW OF LITERATURE

REVIEW OF LITERATURE

Historical review -

Fractures of femoral neck are known since the Hippocrate era. The Ambrose Pare was first to have recognised the existance of hip fracture. Sir Astley Cooper (1822) was the first person to delineate clearly between intracapsular fracture of femur and other fracture around hip. Gult in 1862 believed that if the ends of fractured bone can be kept in accurate apposition, union will take place regardless of site of fracture. Senn (1883) reported that inability to maintain perfect apposition and immobilization of fracture during time require for bone healing is not only cause of non-union and believed most femoral neck fractures heal by fibrous union and patient suffers permanent limpness.

Philips in 1867 introduced biaxial traction in femoral neck fracture to eliminate shortening and other deformity. Whereas, Whitman in 1902 advocated the close reduction and plaster immobilisation in spica cast for these fractures and rate of union in St. Luke's hospital reported 30% union by this method. Cotton in 1911 modified the method of Whitman.

Von Langenbeck in 1850 was first surgeon who attempted to fix these fractures. He was succeeded by

Konig in 1887, Necolaysen in 1897. But method could not gained popularity due to metal incompatability and material failure. The Smith-Peterson and his co-worker invented triflanged nail in 1931 and Johanson and Westcott in 1932 were modified the technique of Smith Peterson. With the advent of S.P. Nail, the mortality decreased from 75% to 25% and union rate increased from 30% to 70%. Many modules of internal fixation cropped up such as Nails, pins, screws, nail plates.

The nineteenth century opinion of Senn (1833) have been amply confirmed by successful results of treatment in countless fractures of femoral neck where perfect reduction and efficient immobilization have been achieved.

The use of cancellous bone grafting along with internal fixation has been recommended by many authors (King, 1939; Wardle, 1945; Patrick, 1949). The Phamister advised the internal fixation of fracture neck femur by cortical bone grafting of Fibula or tibial cortex in an effort to decrease the incidence of non-union and aseptic necrosis following femoral neck fracture.

When surgeon get frustrated with problem of management of femoral neck fracture, they were searching other device. Then following introduction of stainless steel prosthesis designed by Moore and Bohlman in 1940 and Thompson in 1954, then surgeon turned towards primary

prosthetic replacement for fracture neck femur. But it had its own problems like Painful hip, loosening, Revision.

In 1936 Mc Murray and in 1939 Dickson advised the intertrochanteric osteotomy. For stability of hip reducing the pain & deformity. They also advocated fracture neck femur get united. Even without union of fracture neck femur patient could walk.

In 1962 Frankl & Derion were first to give idea of muscle pedicle grafting for improving vascularity. It was experimental work on dog. The Judet (1962) applied the idea of Frankle & Derion in fracture neck femur by muscle pedicle bone grafting and screw fixation got 100% result in a neck femur but it has never been proved that bone graft is essential to union in these fracture.

Anatomical consideration of Head & Neck of Femur

Proximal end of the femur consists of the Head, Femoral neck, Greater trochanter and Lesser trochanter. The femoral neck projects superiorly, medially and anteriorly in relation to shaft of the femur. The neck is broader at its base laterally and narrowest just below and lateral to the femoral head or middle of neck. It is flattened in anterio-posterior plane. The vascular foramina are present on anterio-posterior and posterior superior aspect of neck.

The anatomist of nineteenth century reported that femoral head including bone & cartilage was not spherical

but spheroid. Charnley (1967), Bullough & Goodfellow (1968) and Greenwald & Gayner (1972) were convinced with old nineteenth century's anatomist that head is spheroid which may become more nearly spherical with advancing age.

The recent study by Calheart & Clarks have shown more precisely and subtle variation in radii of femoral head. The distance between equator and tip is 2-3 mm longer than radius of equator. The acetabular shape is coincides with femoral head in anatomical position. The angle between neck and shaft in adult is 125^{o} to 135^{o}.

The antiversion refer to degree of anterior projection of femoral neck from coronal plane of shaft. The transcondylar plane is a plane constructed between line of transcondylar axis and axis of femoral shaft. This is the coronal plane of the femur. The angle of anteversion of femur is the angle between intersection of transcondylar plane and plane constructed by intersection of the axis of femoral neck and axis of femoral shaft. Normally the neck project anteriorly in adults but in small number of cases it projects posteriorly and it is said to be retroversion or retrotorsion (Kingsley & Olmstead, 1948).

The head of femur is completely covered with articular cartilage, except over small roughened pit in which the ligament of head is attached. It is called Ligamentum teres. The Kurrat and obeslander have measured the thickness of articular cartilage in 10 cases. They found

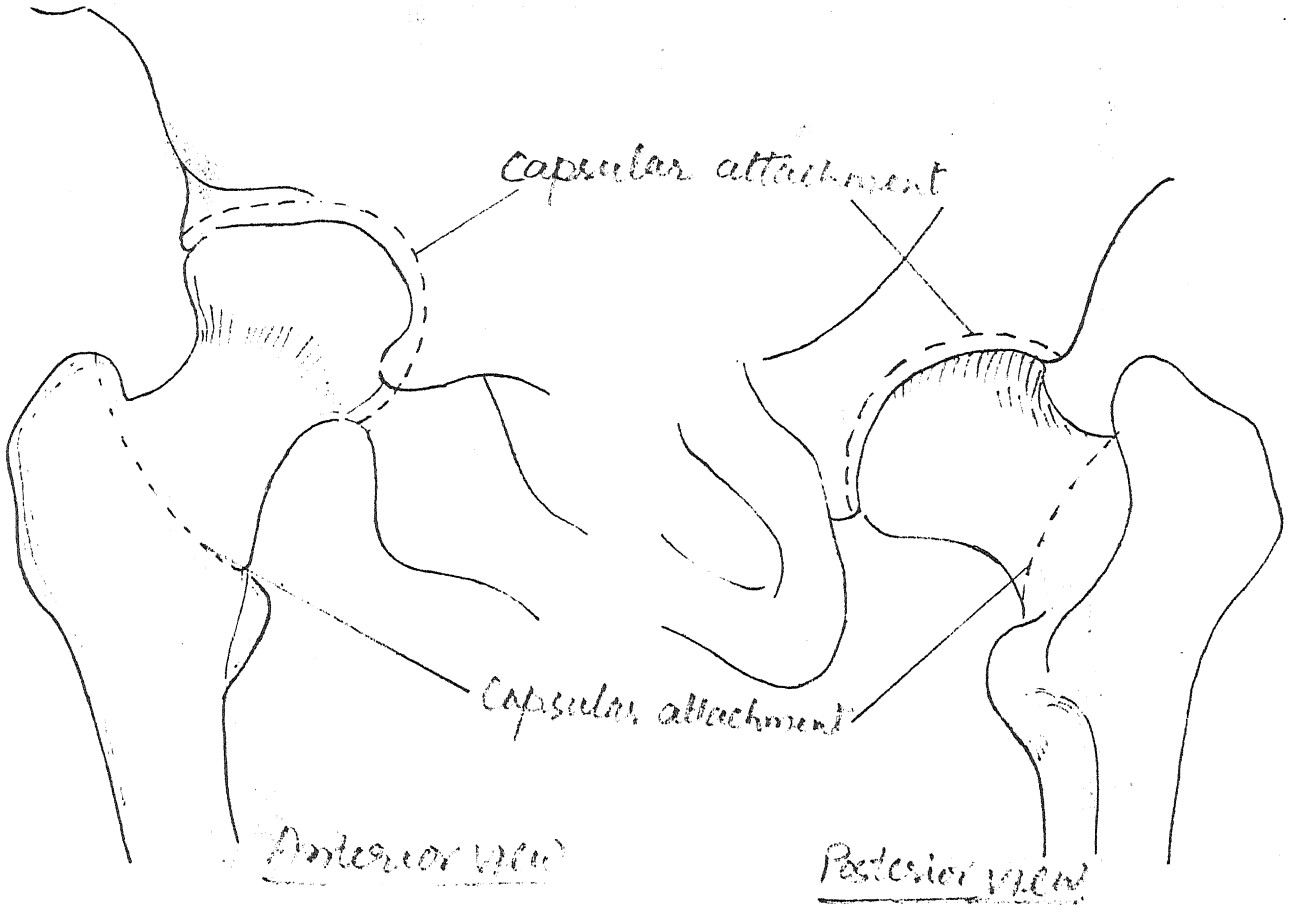
that maximum thickness in acetabulum to be in its ventro-cranial quadrant, whereas that on femoral head is ventro-lateral. The articular surface of acetabulum forms incomplete ring termed the lunate surface.

Synovial membrane is extensive. Commencing at the margin of articular cartilege of head of femur. It covers the portion of neck which is contained within joint capsule from neck it is reflected on internal surface of capsule cover both surface of acetabular labrum ensheathes the ligament of head of femur and cover the mass of fat contained in acetabular fossa. Interior of joint communicate sometime with subtendinous iliac bursa beneath the psoas major tendon, through circular aperture between pubofemoral ligament and vertical band of ilio-femoral ligament.

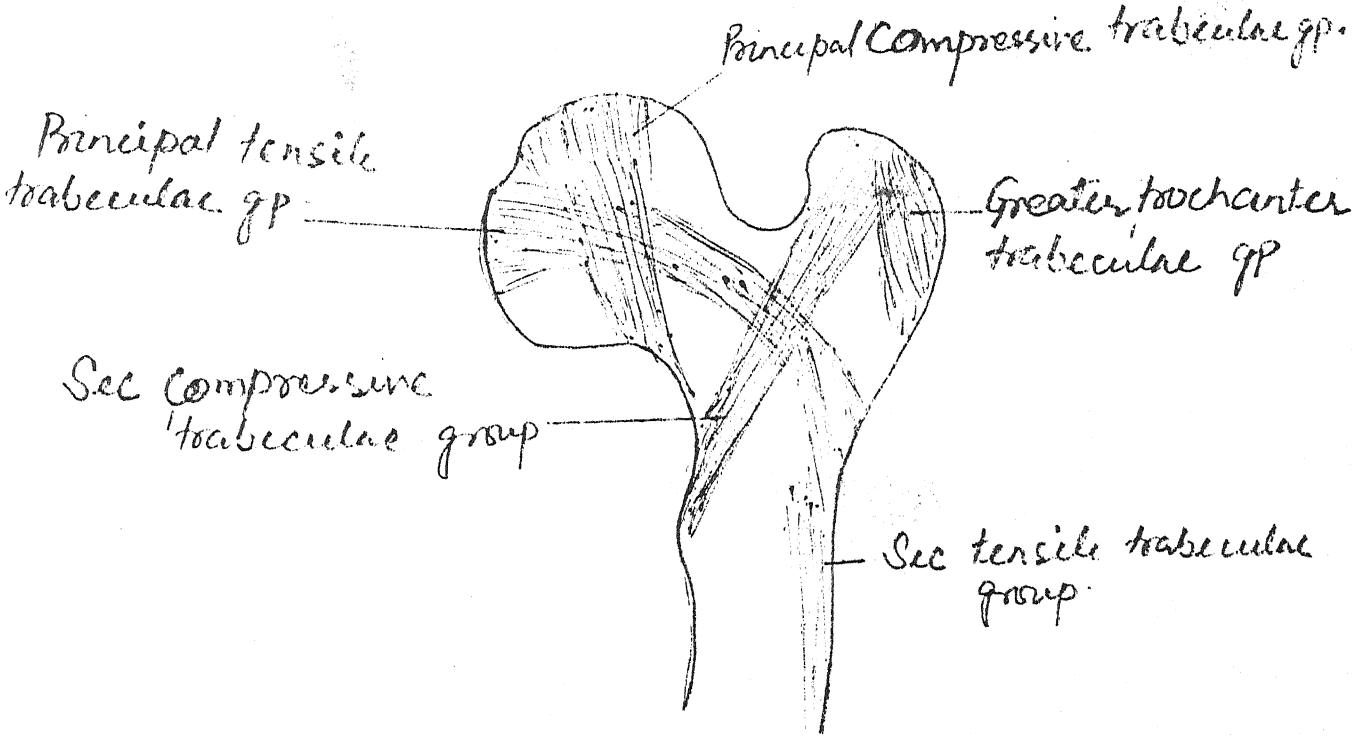
Capsule of hip joint is strong and dense. It is attached above to margin of acetabulum, 5-6 mm beyond the acetabular labrum, in front to outer margin of labrium and opposite the acetabular notch, to acetabular ligament and edge of obturator foramen. It surrounds the neck of femur, and attached in front to intertrochanteric line, above to base of neck, behind to neck about 1 - 1.5 cm above the trochanteric crest, below, to lower part of neck close to lesser trochanter.

Periosteum and bone structure

Beneath the synovial membrane, periosteum covers the proximal femur. The Bank has shown that periosteum



Capsular attachment at Hip Joint



Trabeculae Pattern of Proximal femora

does not have cambium layer on femoral neck which accounts for lack of periosteal bone healing. Therefore, healing in femoral neck area is dependent on endosteal bone healing alone.

The trabecular pattern of proximal femora enable. It is withstand the considerable tensile and compressive force to which it is subjected. The trabecular system of proximal end of femur was first described by Ward (1938). He described five trabeculae groups in proximal end of femur.

1. Principal compressive trabeculae group
2. Principal tensile trabeculae group
3. Secondary compressive trabeculae group
4. Secondary tensile trabeculae group
5. Greater trochanter trabeculae group.

The calcar femorale is described by Sigelo (1900). It is 'the true neck of femur' is vertical plate of the bone lying deep to lesser trochanter. The calcar forms distal anchorage of medial arrangement of trabeculae in internal weight bearing system. This group known as compression group streams, upwards to forward at articular margin of head. The lateral arrangement of trabeculae known as tensile group arises from lateral femoral cortex and comes upward & medially to merge with the compression group in femoral head. A third group of trabecular springs from medial aspect of the cortex at level of lesser trochanter to decurrate with

lateral or tensile trabeculae at junction of neck and shaft of femur.

Harty and Griffin studied calcar as follows. Calcar femorale is a dense vertical plate of bone extending from posterior medial portion of femoral shaft under the lesser trochanter and radiating lateral to greater trochanter, reinforcing the femoral neck postero-inferiorly. The calcar femoral is thickest medially and gradually thins as it passes laterally.

Vascularity of Proximal end of Femur

The avascular necrosis & non-union following the fracture neck femur is due to interruption of vascularity in proximal fragment. So the knowledge of blood supply of upper end of femur should very clear. Surgeon has less control over avascular necrosis than union. Interruption of vascularity enhances the chances of non-union and late segmental collapse.

The arterial supply of proximal end of femur has been studied extensively. The description by Crook, sums the most appropriate because it is based on three plane analysis and provides a standardization of anatomical nomenclature. He described three groups of artery -

1. An extracapsular arterial ring located at base of neck.

2. Ascending cervical branches of extracapsular arterial ring on surface of femoral neck.

3. Arteries of the round ligament.

The extracapsular arterial ring is formed posteriorly by a large branch of medial femoral circumflex artery and anteriorly by branches of lateral femoral circumflex artery, superior and inferior gluteal arteries also have minor contribution to this ring.

Ascending cervical branches arises from extracapsular arterial ring. Anteriorly, they penetrate the capsule of hip joint at intertrochanteric line and posteriorly, they pass beneath the orbicular fibre of capsule. The ascending cervical branches pass upward under the synovial reflexion and fibrous prolongation of capsule toward the articular cartilage, that demarcate the femoral head from its neck. These arteries are known as retinacular arteries. Initially described by Weitbrecht. The proximity of retinacular arteries to bone puts them at risk for injury in any fracture of femoral neck.

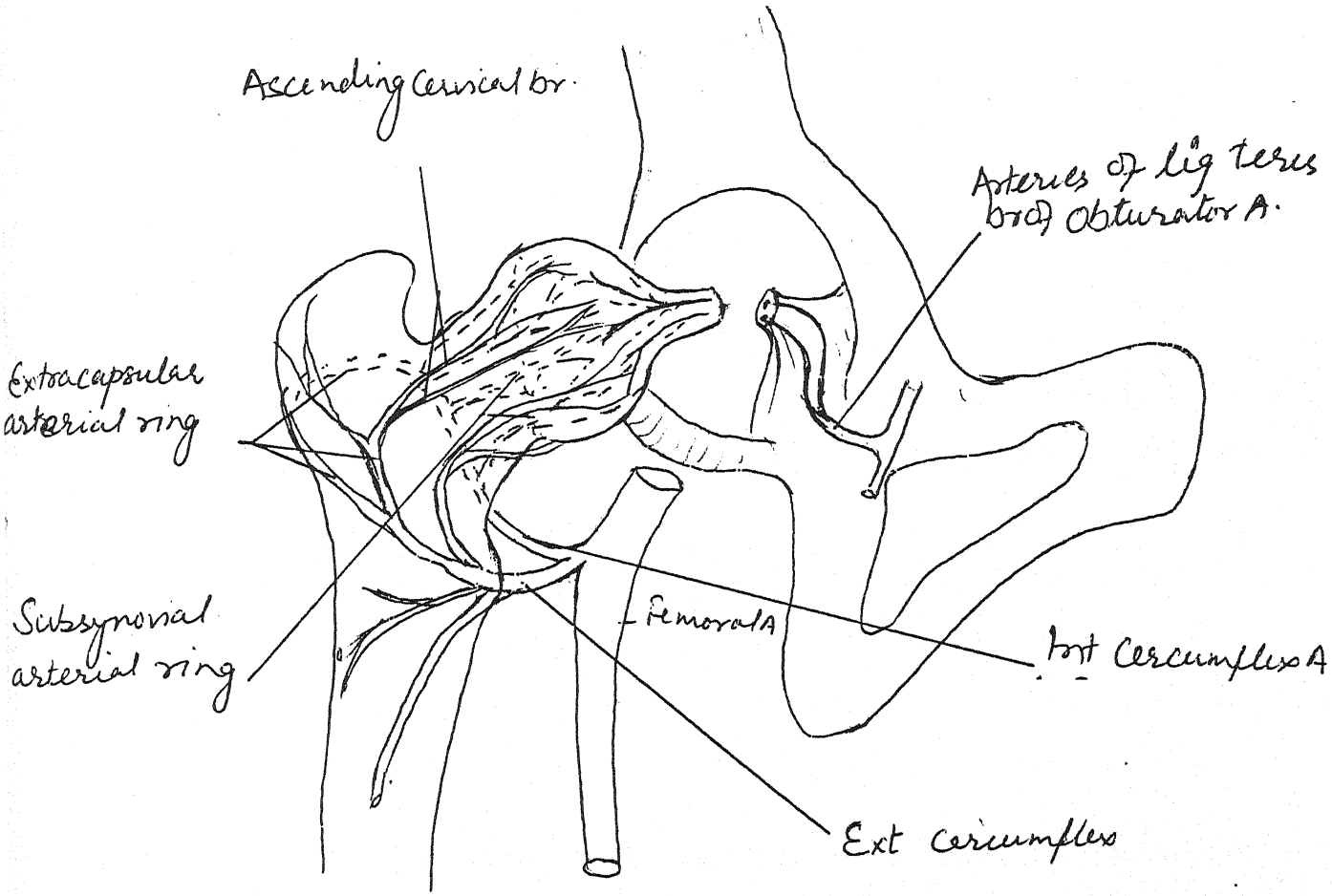
The neck of femur receives additional blood supply from the extracapsular arterial ring by anastomosing with intramedullary branches of the superior nutrient artery system, the branches of ascending cervical arteries and subsynovial intra-articular ring. This excellent vascular supply to metaphysis explains the absence of avascular

changes in femoral neck as opposite to the head. Ascending cervical arteries can be divided into four groups - (1) Anterior, (2) Medial, (3) Posterior, (4) Lateral. Lateral group provide most of blood supply to femoral head and neck.

In the margin of articular cartilage on the surface of neck of the femur, these vessels forms second ring which Chung has termed as subsynovial intra-articular ring. This ring initially was termed as cerculus articularis vasculosus by Willium Hunter (1943). Freucta & Harrison mentioned as incomplete subsynovial ring in 1953. It may be complete or incomplete depends upon variation.

Artery of round ligament supply very small area around the fovea of head of femur. It is branch of medial circumflex femoral artery. It proceeds towards the head along with ligamentum teres. It is not injured in fracture neck femur. But it not so large that can prevent the avascular necrosis of head following displaced fracture of femoral neck.

The revascularisation of femoral head occur through the remaining blood supply by creeping substitution. Actual repair of necrotic bone is much slower process, thereby setting the stage for late segmental collapse. This re-vascularisation after vascular insults, arteries from three sources.



Blood supply of proximal end of femur

1. From area of femoral head that remain viable specially the subfoveal area supplied by artery along ligamentum teres. This revascularisation depend upon intra-osseous vascular anastomosis.

2. Vascular ingrowth across the fracture site. This process is slower than previous one. The fibrous tissue across the fracture site may prevent vascular ingrowth and also delicate and hinder vascular buds, may be repeatedly torn at poorly stabilised fracture site.

3. Revascularisation occur from vascular tissue growing in, from that part of femoral head not covered by articular cartilage. Chung describes a subsynovial articular arterial ring at articular cartilage and neck junction. The disruption of this arterial ring may have particular significance in high intracapsular (subcapital) fracture of neck femur.

Kolodny (1925) was first to describe the blood supply of head & neck of the femur and their importance in pathological fracture of the femoral neck.

Trueta and Harrison (1953) investigated the changes in the vascular arrangement of upper end of femur in period between birth and epiphysial maturation.

Crock H.V. (1965) made a revised study of anatomy of arterial supply of upper end of femur.

Stanley M.K. & Chung (1976) by means of perfusion, studied the arterial supply to proximal end of femur.

Calandrucceo R.A. (1980) did experimental and clinical study over post-fracture avascular necrosis of femoral head.

Mechanism of Injury

Most of the patients suffering from femoral neck fracture have experienced trivial or minor trauma. Only few involve major trauma usually those patient who are young or adult.

Kocher suggested two mechanisms of injury in femoral neck fracture.

First - A fall producing a direct blow over the greater trochanter. This mechanism was confirmed by Linton.

Second mechanism is that of lateral rotation of extrimity. In this mechanism head is firmly fixed by anterior capsule and iliofemoral ligament, while the neck rotates posteriorly. The posterior cortex impinges on acetabulum and neck buckles. This mechanism is compitable with marked posterior comminution of neck emphasised by Scheck.

A third suggested mechanism is cyclical loading, which produces microfracture and macrofractures. It have been shown that fracture in osteoporotic bone can be produced by forces within physiological limit.

In case of young patients with femoral neck fracture, the resultant trauma is major, usually resulting in direct force along the shaft of femur with or without a rotational component. An increased magnitude of trauma leads to more marked soft tissue stripping and comminution which give rise to increased incidence of failure in treatment of these fracture in young adults.

Classification of femoral neck fracture

Sir Astley Cooper was first distinguished the intracapsular fracture of neck of femur from other injury of hip. Various classifications on basis -

1) Anatomical location of fracture,
2) Displacement of fracture fragments,
3) Direction of fracture line.

Some authors classify intracapsular fracture of femoral neck anatomically into subcapital fracture and transcervical fracture. The basal fractures are extra-capsular and not included in fracture neck femur.

Bank divided the fracture neck femur into four types -

1) Classical subcapital fracture,
2) Wedge subcapital fracture,
3) Inferior break fracture,
4) Mid neck fracture.

In this series he also found that trans-cervical fracture was extremely rare.

Fracture Displacement (Garden's Classification)

Garden (1976) proposed a classification system based on degree of displacement of fracture noted on pre-reduction X-rays. Garden's Classification divides the fracture into four stages of displacement.

Grade I - Incomplete fracture, commonly known as abducted or impacted fracture.

Grade IInd - Complete fracture without displacement.

Grade IIIrd - Complete fracture with displacement but with the fracture surfaces still in apposition postero-inferiorly.

Grade IVth - Complete fracture with full displacement. The contact between fracture surfaces has been lost and thus proximal fragment is free to resume its natural position in acetabulum. The direction of its medial group of trabeculae lost the alignment with these projection in the pelvis.

Fracture angle

Pouwel's Classification (1935) divided the femoral neck fracture into three types based on direction of fracture line across the femoral neck.

Type I - Pouwel's angle upto 30^{o}

Type II - Pouwel's angle 30^{o} to 50^{o}

Type III - Pouwel's angle 50^{o} to 70^{o}

A.O. Classification

In A.O. Classification system, fracture of femoral neck are classified as follows -

B_1 - Subcapital fracture with no or minimal displacement.

$B_{1.1}$ - Impacted in valgus of 15^{o} or more

$B_{1.2}$ - Impacted in valgus of less than 15^{o}

$B_{1.3}$ - Non impacted fracture.

B_2 - Transcervical fracture

$B_{2.1}$ - Basicervical

$B_{2.2}$ - Midcervical with adduction

$B_{2.3}$ - Midcervical with shear.

B_3 - Displaced subcapital fracture

$B_{3.1}$ - Moderately displaced in varus and ext. rotation.

$B_{3.2}$ - Moderately displaced with vertical translation and Ext. rotation.

$B_{3.3}$ - Markedly displaced.

Type B_3 fractures have worst prognosis.

Treatment -

Though there are innumerable methods of treatment of intracapsular fracture neck femur available in literature. But still there is no concensus about most satisfactory method of treatment for these fractures.

According to literature available, Von Langenbeck (1878) was the first to treat these fractures by internal fixation. His attempt failed due to sepsis as antibiotics and concept of sterilization were not known in that era, the method was not accepted by surgeons of that era.

Whitman (1904) need close reduction and plaster immobilisation as a method of treatment of these fractures. But union rate was less than 30%.

In 1931 Smith Peterson and his co-workers revolutionised the treatment of fracture neck femur and designed a triflanged nail for internal fixation of these fractures and reported upto 70% union rate.

Mc-Murray was not convinced by these method of treatment for intracapsular fracture of neck femur. In 1936 he advised intertrochanteric osteotomy to change the axis of weight bearing. Pauwel modified the technique of Mc Murray and adviced osteotomy that reduces the shear force acting on fracture site. The disadvantage of osteotomies is limb length discrepancy.

In 1939 King advised fibular bone graft with Smith Peterson nail in patients whom fracture was less than three months old, head was vascular and without much absorption of neck. He preferred osteosynthesis over osteotomies.

In 1940, came the concept of replacement of proximal segment of femur. Austin Moore developed the prosthesis for

this purpose, but it could be used in only those cases who had sufficient intact calcar femorale. To overcome the limitation of Austin Moore prosthesis, Thompson designed his prosthesis in 1954. Thompson prosthesis can be used for replacement of proximal segment of femur in which femorale calcar is not available.

In 1943 Blount revolutionised the outlook of osteotomy by using blade plate for internal fixation of high femoral osteotomy and reported 72% union rate.

In 1950 King compared the results of osteotomy and osteosynthesis by S.P. Nail and concluded that -

1. The success rate is 69% with nailing alone, 71% with nailing and bone grafting and 72% with primary osteotomy.

2. Incidence of avascular necrosis is less after primary osteotomy i.e. 4% as compared to 28% after nailing and bone grafting.

Jewet et al (1961) propound his one piece nail plate device for fixation of femoral neck fractures.

In 1961 Garden R.S. observed that medial weight bearing trabeculae are directed at angle of 3-8 degree to the perpendicular axis of femur. Therefore, he concluded, low angled vertically placed fixation device is more sound than horizontally placed device for fixation of fracture neck femur. On this concept he developed Garden's screw fixation device.

In 1962 Frankel & Derion came forward with the idea of muscle pedicle bone grafting to improve the vascularity of proximal femoral fragment and reported 100% union rate in their experimental work. In 1962 Doyen & Judet were first used this concept in human being and reported clinical use of muscle pedicle bone grafting of quadratus femoris muscle as means of improving vascularity of proximal fragment in displaced femoral neck fracture and opened a new chapter in management of fracture neck femur.

Price (1962) advocated that diminished vascularity is not only factor concerned in non-union. Union can be even achieved in avascular head if it is rigidly fixed to a vascular neck. He stressed that fixation device are not as important as reduction. No device can hold a badly reduced fracture.

Baadsgaard and Medgyesi (1963) demonstrated by angiography that blood supply of such pedicle graft is not better than would be expected from osteogenic activity because approximately 50% of osteocytes degenerate. He also stated that, for viability of pedicle graft, following factors play role -

1. Graft should be handled atroumatically,
2. No torsion of pedicle,
3. There should be no tension in pedicle on flexion and extension of hip.

In 1964 Michael Boneliglio adviced multiple drilling and cortical bone grafting in aseptic necrosis of femoral head with or without fractured femoral neck. He got 78.4% favourable result and reiterated that if this procedure fails then salvage procedures (Prosthetic replacement, osteotomy) should be done for further management.

In 1967 Meyers et al began the use of quadratus femoris pedicled bone graft in fracture neck femurs. They showed significant improvement in results by use of muscle pedicle bone graft technique. They reported 88% union rate and 5% late segmental collapses. The vascularity was determined by serial roentgenogram. They popularised this technique in management of fracture neck femur. In 1977 he again reported 95% union rate and no segmental collapse by use of muscle pedicle bone grafting. In this series, vascularity was assessed by sulphur colloid.

William D. Arnold (1974) treated the intracapsular fracture neck femur by close reduction and percutaneous multiple pins fixation. He stated that this technique is simple, safe and reasonable effective method of treatment of non-pathological fractures neck femur.

Mark F. Swientkowski (1975) studied the results of osteosynthesis in femoral neck fracture by close reduction and internal fixation by 6.5 mm and cancellous screws parellar to plane of neck femur. Surgery was performed within eight hours after injury. All of the fractures were united.

In 1982 Penschuck studied the results of femoral neck fracture treated by three A.O. cancellous screw. He got good results in Garden's type I & II, but poor results in Garden's type III & IV in elderly patients. So he advised type III & IV fractures should be treated by Hemi-replacement or total replacement arthroplasty.

D.P. Buksi (1983) reported excellent to good results of muscle pedicle bone grafting, multiple drilling and fixation by multiple pins in ununited fractures neck femur. In 1986 he reported another series of ununited fracture neck femur those presented late. All had some absorption of femoral neck, many had avascular necrosis of femoral head. At operation, the sclerosed surfaces of fracture were freshened, avascular head were decompressed and muscle pedicle graft was fixed. He got 75% satisfactory union, 18% delayed union and 7% remain ununited.

William Arnold in 1984 concluded that early weight bearing is beneficial than late weight bearing even in those fractures which are not rigidly fixed but having good reduction. His philosophy was to enhance the impaction of fracture by early weight bearing.

Lass Rehnberg, Claer Olerud(1987) used the cannulated cancellous self tapping screw for fixation of fracture neck femur. They achieved 100% union rate and no case reported for loosening of screws.

In 1988 Gupta et al reported 80% union rate of intra-capsular fracture neck femur by muscle pedicle bone grafting and internal fixation by A.O. cancellous screws.

Li Wan Guan (1993) reconstructed the absorbed neck in old fracture neck femur by using two vascularised bone graft from iliac crest, one based on vascularised pedicle from deep circumflex femoral vessel and other on muscle pedicle of sartorius muscle. These graft were fixed by three pins. He advocated the advantages are -

i) No limb length discrepancy,

ii) No limping in gait.

In 1994 Asnis reviewed the results of intracapsular neck fracture by cannulated cancellous screw fixation. They got 96% union rate in their 141 series.

Seato et al in 1995 studied the results of osteo-synthesis with muscle pedicle bone grafting in 82 patients and reconfirmed that anatomical or near anatomical reduction helps to promote union. They further observed that amount of pre-operative displacement less than 20 mm had the tremendous effect on bone healing and excellent results.

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MATERIAL AND METHODS

MATERIAL AND METHODS

Ten cases of fracture neck femur, both fresh as well as ununited or neglected, attending Orthopaedics out-patient department and Emergency department of M.L.B. Medical College Hospital, Jhansi, were thoroughly examined clinically and radiologically. The below knee traction was given to each patient till waiting for surgery. All cases were treated by open reduction and internal fixation by cannulated screws and muscle pedicle bone grafting.

Criteria for selection of cases -

All the cases of ununited fracture neck femur having age 20 - 60 years constituted the subject of this study with following exception -

1. Inability to walk due to other than fracture.
2. Those unable to co-operate in post-operative program because of psychosis, mental retardation, parkinsonism and cerebrovascular accidents with residual hemiparesis, paraplegia and spasticity.
3. The patient with poor health who can not withstand too major operation.

Pre-operative assessment -

All patients were kept on B/K, skin traction and Thomas splint. All patients were thoroughly examined clinically, radiologically and investigated for general condition of patient regarding fitness for operation and anaesthesia.

Length of cannulated cancellous screw was measured pre-operatively by help of X-ray of opposite hip. Length is measured from subcondral bone of head of femur to lateral femoral cortex at level of lesser trochanter. This obtained length is multiplied with seven by eight to cancel the effect of X-ray's magnification. This obtained length is again reduced by 5 mm. This final obtained length is actual length of cannulated cancellous screw.

Surgical Approach :

Anaesthesia - General / Spinal / Epidural according to suitability of patient or choice of anaesthetist.

Position of Patient : Prone position on operation table, to keep abdomen free for respiration. Pillows were placed under the chest & pelvis and knees to prevent fixation of fracture in flexion. The heels kept exposed to see rotation of the limb periodically during surgery.

Approach -

Fractured neck femur was exposed by posterior Moore's approach (Southern approach). Incision starts about 10 cm

distal to the posterior superior iliac spine extending distally and laterally with the direction of fibres of Gluteus maximus muscle upto the tip of greater trochanter, extending distally to the lateral aspect of thigh about 10-12 cm around lateral surface. Gluteus maximus muscle splitted in direction of its fibre. Sciatic nerve identified and retracted medially. The quadratus femoris muscle identified and limb rotated internally. The rectangular graft is marked out with a fine osteotome on the inter-trochanteric crest of femur about 3x2 cm measurement. The bone graft is taken out with the help of fine chisel about 1 to 1.5 cm thick with attached muscle pedicle and retracted medially towards the lateral aspect of ischial tuberosity.

The evidence of circulation on cancellous surface of bone graft as well as substance of attached quadratus femoris muscle was always noted. This was seen by free oozing on cancellous surfaces of bone-graft and muscle maintained the reddish appearance of normal muscle.

After preparation of graft, the external rotators of hip were incised and retracted medially and inverted T incision is given in posterior surface of capsule of hip joint. The stem of which started from acetabular labrum and end at femoral attachment of capsule. Then fracture site is readily seen. The soft tissue impingment were cleared off and fracture surface were examined for sclerosis in old neglected case. If sclerosis were present, then it freshened. If vascularity is dubious then decompression

was made by multiple drilling. Then fracture surface were reduced by traction, abduction and internal rotation under vision.

Then one guide wire introduced into head of femur through lateral surface of trochanteric flare opposite to the lesser trochanter by help of angle guide. The position of this guide wire was checked by per-operative roentgenogram. If X-ray control was not available, then this guide wire is introduced into neck of femur into centre of neck and directly check by vision by rotating the femur if it was satisfactory, then proceed this wire into head after anatomical reduction. Then other three guide wires were introduced into head of femur parallel to principal guide wire. Length were measured by direct measuring device and pilot hole were made over guide wire by cannulated drill bit. Then pilot hole were tapped by cannulated tap over guide wire. Then cannulated cancellous screws were driven over guide wire across the fracture site. Finally all guide wires removed and stability and rigidity of fixation assessed direct under vision.

After rigid fixation of fracture, recipient bed were prepared by help of fine gauze on posterior surface of neck, across the fracture site upto base of head and comminution gap were filled with free cancellous bone graft obtained from flare of trochanteric region. Then prepared muscle pedicle graft fixed over prepared bed by help of stapple without any tension and torsion in pedicle of graft.

The common tendon of obturator internus and gemelli were again reattached to its original insertion, and wound closed layer by layer under sucction drain.

Post-operative treatment -

Post-operatively no external splintage was applied. Suction drain was removed within 24 to 48 hours after surgery. The isometric quadriceps exercises were encouraged same evening or 2nd post-operative day according to pain tolerance in patient. Sutures were removed on 10th to 12th day of surgery. Active hip exercises were started earliest possible as per pain tolerance of the patients.

Criteria for the perfect reduction are the Garden's alignment index, utilising standard radiographic view. The normal angle between the medial trabeculae of femoral head and medial cortex of femoral shaft is 160°. The central axis of femoral head & neck in lateral view normally be in straight line is 180°. A perfect reduction can be called as an alignment index (A.P. angle / lateral angle) of 160°/ 180°. A reduction producing an angle of 155° to 180° in each view should be considered acceptable.

The patients were allowed graduated weight bearing after three months, first with pair of crutches, then stick on opposite hand. The full weight bearing were not allowed till fracture consolidation radiologically.

In follow-up, all patients were called at 6 weeks interval and examined clinically & radiologically. The findings were recorded in working proforma as below.

I. Clinical assessment -

At 2 months -
- Condition of wound,
- Presence of pain,
- Gain of power.

At 3 months -
- Condition of wound,
- Presence of pain,
- Ability to lift the limb against gravity,
- Ability to walk with supported,
- Limb length discrepancy,
- Range of movements,
- Functional status,
- Power of muscles around hip & knee joints.

At 4th, 5th and 6th months -
- All above criteria with ability of patient to walk with crutches or unsupported.
- Ability to squat and sit cross-legged,
- Range of movements at hip joint,
- Return of routine work.

II. Radiological assessment - was done at regular intervals of 1½ months to see -

1. Whether fixation was secured,
2. Stage of union at fracture site,

3. Extrusion of screws,
4. Any evidence of absorption of neck of femur,
5. Any sign of segmental collapse or avascular necrosis.

The final results of function of hip were evaluated according to Larsen criteria given in 1963. It was mathematical criteria as below :

A. Function (35 points) :

Does most of house-work or job which require moving about	5
Dresses unaided (in tying shoes and putting on socks)	5
Walks enough to be independent	5
Sits without difficulty at table or toilet	4
Picks up objects from floor by squatting	3
Bathes without help	3
Negotiates stairs foot over foot	3
Carries objects comparable to suitecase	2
Gets into car or public conveyance unaided and rides comfortably	2
Drives a car	1

B. Freedom from pain (35 points) (Circle 1 only).

No pain	35
Pain only with fatigue	30
Pain only with weight-bearing	20
Pain at rest but not with weight-bearing	15
Pain at sitting or in bed	10
Continuous pain	0

C. Gait (10 points) (Circle 1 only) :

No limp; no support	10
No limp, using cane	8
Abductor limp	8
Short-leg limp	8
Needs 2 canes	6
Needs 2 crutches	4
Cannot walk	0

D. Absence of Deformity (10 points) :

No fixed flexion over 30°	3
No fixed adduction over 10°	3
No fixed rotation over 10°	2
Not over 1" shortening (ASIS-MM)	2

E. Range of Motion (10 points) :

Flexion-extension (normal 140°) .....°

Abduction-adduction (normal 80°) .....°

External-internal rotation (normal 80°) .....°

Total degrees .....°

Points (1pt./30°) .....

The total score ninety and above will be considered as excellent, between eighty to eighty nine as good results, seventy to seventy nine will be considered as fair results and less than seventy score will be poor results.

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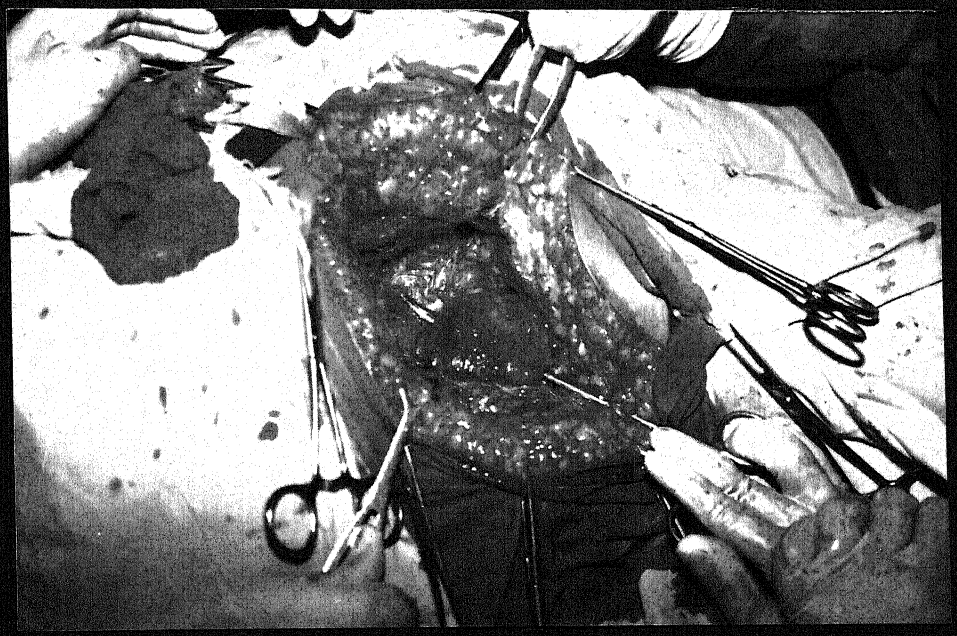
1. Instrument set and implant

2. Position of Patient and drapping

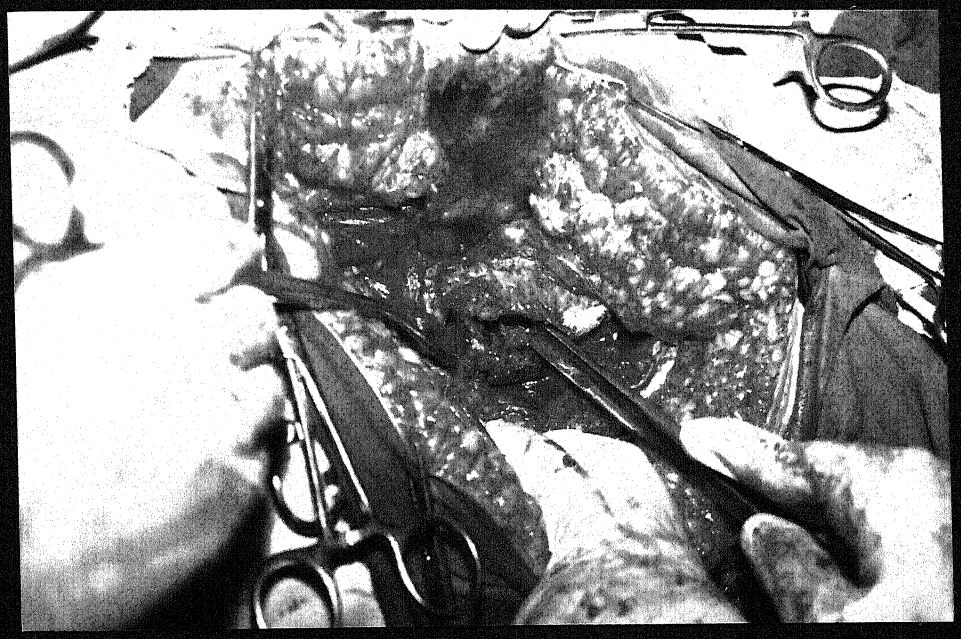


3. Showing quadratus femoris muscle

4. Showing quadratus femoris muscle pedicle bone graft removed

5. Temprary fixation of fracture by multiple guide wires

6. Fracture fixed by multiple cannulated Cancellous screws



7. Cancellous bone graft optaining from G.T.

8. Muscle pedicle bone graft fixed by staple across the tracture site

OBSERVATIONS

OBSERVATIONS

The present study has been conducted in the Department of Orthopaedics, M.L.B. Medical College & Hospital, Jhansi. All ten cases of femoral neck fractures, fresh as well as ununited or neglected cases below sixty years of age group were treated by open reduction and internal fixation by multiple cannulated cancellous screws with muscle pedicle bone grafting, those were admitted in Emergency department as well as out patient department.

Table I

Showing the incidence of age.

Age group in years	No.of cases	Percentage
< 20	Nil	-
21 - 30	1	10.00
31 - 40	4	40.00
41 - 50	3	30.00
51 - 60	2	20.00
Total	10	100.00

Our youngest patient's age was 28 years and oldest one was 56 years old. Our maximum patients were having age between 4th decade of life. Average age of our patient was 42 yrs old. Patients having age beyong 60 years were not included in this study.

Table II

Showing the sex incidence.

Sex	No. of cases	Percentage
Male	7	70.00
Female	3	30.00
Total	10	100.00

Majority of our cases (70%) were male and got injury into road side accidents. Our female patients (30%) were injured by slipping from floor and their age was above 46 years.

Table III

Showing site of fracture neck femur.

Side of fracture neck femur	No. of cases	Percentage
Right	5	50.00
Left	5	50.00
Total	10	100.00

In our study 50% cases were having fracture neck femur in right side and 50% cases were having injury in left side.

Table IV

Showing the grading of fracture according to Garden's Classification.

Grade	No. of cases	Percentage
I	-	-
II	-	-
III	8	80.00
IV	2	20.00
Total	10	100.00

Table IV shows the severity of fractures according to Garden's Classification. Our 80% patients were having Grade III and (20%) Grade IV fractures.

In our study, majority of cases, both fresh as well as ununited fracture were not received any treatment. Few of them got indigenous treatment for these fractures. But they had not got improvement and fracture remain ununited.

Table V

Showing time elapsed between fracture and operation.

Time elapsed	No. of cases	Percentage
< 3 weeks	1	10.00
3 to 6 weeks	6	60.00
> 6 weeks	3	30.00
Total	10	100.00

Majority (60%) of our cases were operated within a period of three to six weeks after the injury and having mild absorption of neck. Two out of three patients were operated after six weeks interval, one was operated after 56 days after injury, other one was operated after 64 days after injury. Both were having absorption of neck and sclerosed fracture margin. They required freshening of fracture surfaces and decompression of femoral head by multiple drill holes in femoral head.

Table VI

Showing muscle pedicle bone graft used.

Name of muscle pedicle bone graft	No.of cases	Percentage
Quadratus femoris	10	100.00
Sartorius	-	-
Gluteus medius	-	-
Total	10	100.00

In our study we got posterior comminution in majority of cases and healthy quadratus femoris muscle for vascularised bone grafting in fracture neck femur. Therefore, we used quadratus femoris muscle pedicle bone grafting in all cases.

We were prepared to use gluteus medius muscle pedicle bone grafting, if quadratus femoris muscle did not fulfil the standard criteria for healthy muscle.

We were also prepared for sartorius muscle pedicle bone grafting if patient were having anterior comminution in fracture neck femur through Smith Peterson approach. We did not got any patient having anterior comminution in fractured neck femur pre-operatively. Thus we did not used Sartorius pedicled bone grafting in any case.

Table VII

Showing per-operative finding.

Per-operative finding	No.of cases	Percentage
Comminution in posterior cortex	5	50.00
Comminution in anterior cortex	Nil	-
Interposition of capsule	7	70.00
Sclerosis at fractured surfaces	3	30.00
Absorption of neck	2	20.00
Avascular necrosis of head	Nil	-

Our per-operative finding during open reduction were as following :

- Our 50% cases were having posterior comminution in femoral neck. None of the cases were having anterior comminution in fractured neck pre-operatively as well as per-operatively.
- Our 70% cases were having soft tissue interposition. We removed soft tissue interposition before reduction and fixation of fracture.

- All the old neglected cases (30%) of our study were having sclerosis at fractured surfaces and absorption of neck.
- We did not included cases those were having avascular necrosis pre-operatively and they were treated by hemi-replacement arthroplasty.

Table VIII

Showing the quality of reduction achieved according to Garden's criteria.

Quality of reduction	No.of cases	Percentage
Good	7	70.00
Satisfactory	2	20.00
Poor	1	10.00
Total	10	100;00

Table VIII shows that we achieved (70%) good reduction and (20%) satisfactory reduction. In one case we could not achieve reduction resulted into loss of fixation. One case was having valgus reduction. Comminution often posed difficulty to achieve anatomical reduction. The main problem was faced, to keep femoral head anatomically in relation to acetabulum. It rotated when the first guide wire strick to head and sometime it also rotated when second guide wire strick to head as well.

Table IX

Showing the quality of fixation.

Fixation	No. of cases	Percentage
Secured	9	90.00
Unsecured	1	10.00
Total	10	100.00

Per-operatively as well as post-operative roentgenogram showed secured fixation in (90%) of our cases. In one case fixation was not secured due to marked comminution across the fracture site. X-rays showed loss of fixation in first follow-up and finally she had poor results.

Table X

Showing donor site for cancellous bone graft.

Site of cancellous bone graft obtained	No. of cases	Percentage
Greater trochanter	10	100.00
Iliac crest	Nil	-
Total	10	100.00

Table X shows that we obtained sufficient cancellous bone graft to fill-up the gap between head and neck or comminution site from greater trochanter. Therefore, we did not used separate incision to obtain cancellous bone graft from iliac crest and did not lengthen operative time and additional trauma to patient.

We always tightly packed the cancellous bone graft in gap in all cases, not only put the free cancellous graft in gap.

Table XI

Showing incidence of post-operative complication.

Complication	No. of cases	Percentage
Superficial infection	2	20.00
Deep infection	1	10.00
Loss of fixation	2	20.00
Avascular necrosis	Nil	-

Our two cases were having superficial infection, those were cured by proper antibiotics and regular dressing. One case was having deep seated infection, which was not cured by antibiotic and sufficient drainage, ultimately required debridement, removal of implant and removal of head as well.

Our two patients lost the fixation, one due to premature weight bearing against the advice, other one due to poor reduction and insecured fixation. These two cases required Mc Murray's osteotomy. We did not notice avascular necrosis of femoral head in our series probably due to short period of our follow-up.

Table XII

Showing the incidence of post-operative limb length discrepancy.

Limb length discrepancy in centimeter(Apparent)	Shortening		Lengthening	
	No.	%	No.	%
∠ 1 cm	-	-	1	10.00
1 - 2 cm	2	20.00	-	-
2 - 3 cm	-	-	-	-
7 3 cm	-	-	-	-

Table XII shows that two patients out of ten were having shortening of limb due to -

1. Marked absorption of neck.
2. In one patient the fixation was lost in post-operative period.
3. In one patient having one centimeter lengthening due to fixation of fracture in valgus position (20^{o}).

Table XIII

Showing ability to squat.

Ability to squat (Duration in weeks)	No. of cases	Percentage
∠ 12	-	-
12 - 18	5	50.00
18 - 24	2	20.00
7 24	-	-
Unable to squat	3	30.00
Total	10	100.00

Three patients out of ten were not able to squat. In two of them reduction were lost in post-operative period, other one patient got deep seated infection.

Table XIV

Showing ability to sit cross-legged.

Ability to sit cross-legged (duration in weeks)	No.of cases	Percentage
∠ 12	-	-
12 - 18	2	20.00
18 - 24	4	40.00
7 24	1	10.00
Unable to sit cross-legged	3	30.00
Total	10	100.00

Three of them, either reduction were lost due to comminution or weight bearing against advice or deep seated infection.

Table XV

Showing the end results.

Results	No. of cases	Percentage
Good	5	50.00
Fair	2	20.00
Unsatisfactor (Poor)	3	30.00
Total	10	100.00

According to Larson criteria for evaluation of results of hip joint, our five cases out of ten cases having good results, two cases having fair results and three cases having poor results.

There are no breakage of cancellous screws in each cases and no loss of fixation of muscle pedicle bone graft.

Table XVI

Shows time taken in consolidation of fracture.

Time in weeks	No. of cases	Percentage
∠ 12	1	14.3
13 - 18	4	57.1
19 - 24	1	14.3
25 - 36	1	14.3
Total	7	100.0

Majority of our cases consolidated roentgenographically within 13-18 weeks. One case consolidated within 12 weeks which was fresh case, one case taken about 19-24 weeks for consolidation, rest one case consolidated after 30 weeks due to marked absorption of neck and landed into delayed union.

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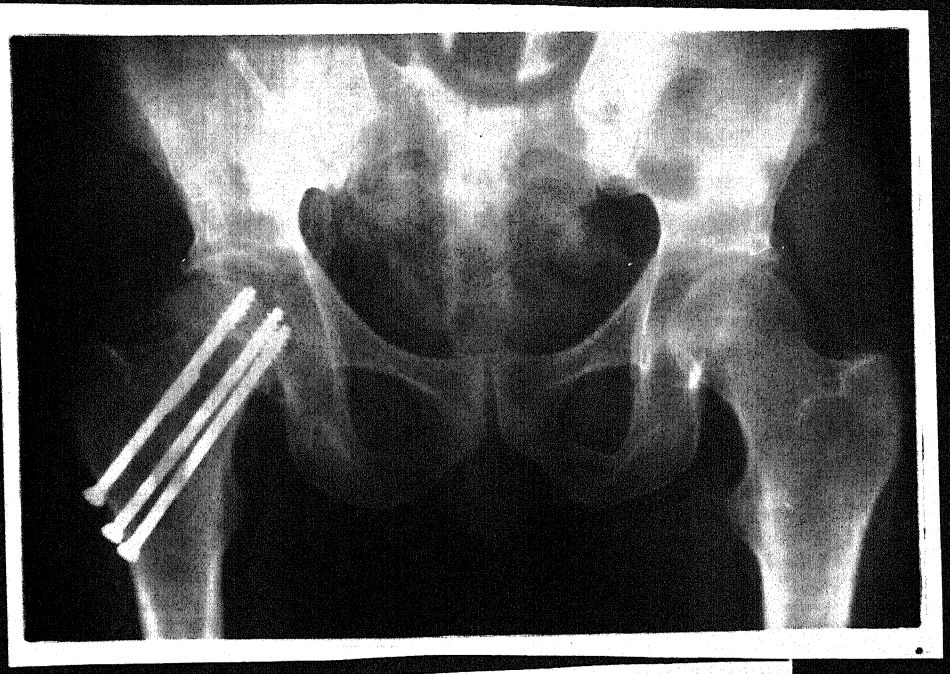
9. Case 1. Preoperative Xrays

10. Xray pelvis with both hip- A.P. view

11. Xray Rt hip -lat view

12. Case No.1 Post operative Xrays

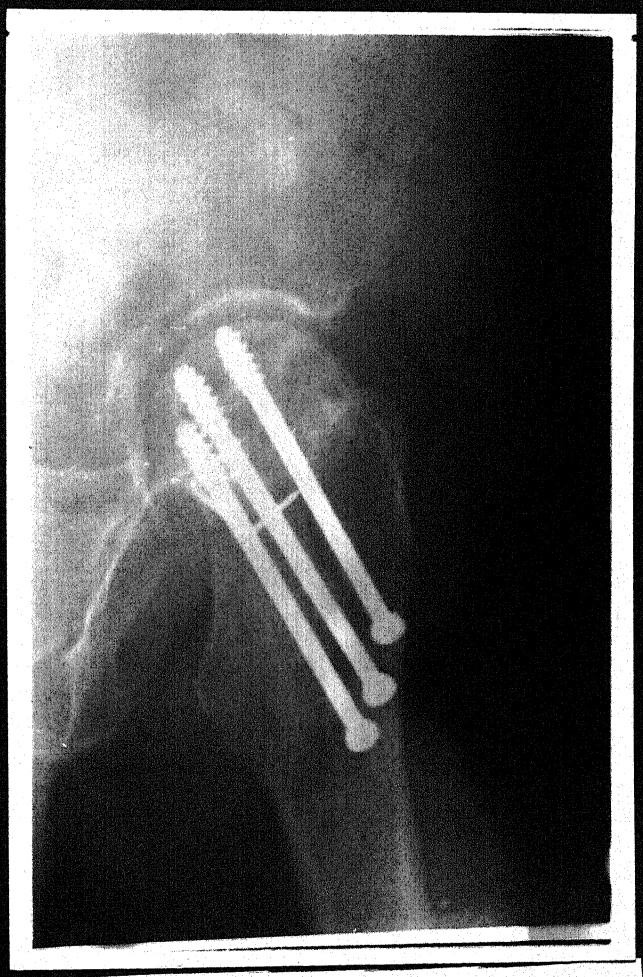


13. Xray pelvis with both hip A.P. view

14. Xray Rt hip -lat view

15. Case No.1 Xryas 6 month after surgery

X.ray pelvis with both hip
A.P. view



25. X-ray Rt hip -lat view

18. Clinical photographs

19. Showing stright leg raising

20. Full weight bearing on fractured limb

21. Squatting of patient

22. Cross leg sitting

D I S C U S S I O N

DISCUSSION

Femoral neck fracture though common in occurrence and known since time immemorial, has always been posing challenge to Orthopaedic surgeons. Inspite of voluminous work and various modalities of treatment available, significant differences of opinion, regarding the best method of treatment, persists even today. Anatomical reduction, impaction and rigid internal fixation are considered to be the pre-requisites for union of femoral neck fractures. Non-union and avascular necrosis of femoral head are the frequent complications faced by the Orthopaedic surgeons. Most orthopaedic surgeons opine that viable femoral head has good functional results, as compared to prosthetic head. To overcome these problems, many surgeons (Helstadius, 1942; Stuck and Hinchey, 1944; Baadsgaard and Medgyesi, 1965) came up with the idea of increasing the vascularity of femoral head by vascularised bone graft.

Femoral neck fracture, though occurs at all ages, is common in young and elderly persons. The higher incidence of femoral neck fracture in old age, is well established (Frangakis, 1966; Barnes, 1976; Brown, 1976; Garden, 1976; Preston and Nicoll, 1976). Our observations showed the higher incidence in young adult males (Table I & II) which is in contradiction to the established fact of higher incidence

in elderly females (Frangakis, 1966; Barnes, 1976; Brown, 1976; Garden, 1976; Preston and Nicoll, 1976). Both these contradictory findings are because the persons beyond the age of 60 years were not included in our study and majority of the patients of this study sustained injury in roadside accidents, to which the young or adult males are more predisposed.

Table III shows that there was no predilection of site of the injury and both sites are equally involved. Similar observations have been made in literature by Trucata (1957); H.P. Boyd (1964); J.T. Brown (1964) and Garden (1976).

Majority of our cases (80%) were unstable fractures and could be classified as Grade III of Garden's Classification. Rest of our cases had almost vertical fracture line (Garden's type IV). These findings are in accordance with observations made by majority of surgeons (Boyd, 1964; Smyth, 1964; Mayers, 1973; Willium, 1984; Claes Olerud, 1989) working on this subject.

Table V shows that 60% of our cases could be operated after three weeks of injury, meaning by that they were old neglected cases. The delay was because of many factors, either patient reported late to us or surgery was delayed due to multiple problems of a government hospital beyond our control or failure to get clearance from

anaesthetist for anaesthesia. In three cases, more than six weeks old, the head was decompressed and femoral neck was reconstructed by cancellous graft taken from greater trochanter as also recommended by L. Wain Gaun (1993).

Several muscles have been described as viable muscle graft such as - Quadratus femoris, Gluteus medius and Sartorius. We used quadratus femoris muscle because it is present in the same operative field and does not need other incision and does not add much operative trauma or operative time. Muscle is broad and based on intertrochanteric area where the cortical bone is thin and cancellous bone in abundence. Thus the broad surface of cancellous bone is available at the fracture site. Thus apart from providing a viable pedicle, it provides bone graft as well to fill the gap at fracture site and secures fixation of fragment to prevent posterior tilt of femoral head. Meyer (1979) and Baksi (1986) also reported that, viable inlay muscle pedicle bone graft helps in revascularization of femoral head and thus in osteosynthesis. Fixation of muscle pedicle bone graft to the recipient site has been done by silk (Baksi, 1986), Screws (Meyer, Harvey and Moore, 1973) and pins. We fixed the muscle pedicle bone graft with a staple as it provide better fixity of graft to the recipient site as well as fixed two fragments of fracture, when proximal fragment was big. Baksi (1986) reported that fixation of muscle pedicle bone graft by silk appeared more advantageous than that achieved by screws or pins.

All patients were operated on ordinary operation table under regional or general anaesthesia in prone position, pillows were placed under the chest, pelvis and knees with foot projecting beyond the table. So as to permit easy manipulation of limb during surgery thus achieving the reduction. The fracture was exposed through popular Moore's (southern) approach and the per-operative findings were recorded.

Interposition of capsule was very common finding and 70% of our cases had interposition of posterior capsule with or without comminution of posterior cortex. The interposition of capsule at fracture site has also been reported by few workers such as Campbell (1980), but has not been emphasized to this gravity as evident by our findings. The open reduction helped in removing interposed capsule at fracture site, one of the important cause of non-union at fracture site.

The comminution of posterior cortex was the other important per-operative finding which was found in 50% of our cases. Comminution of posterior cortex has also been observed by Frangakis (1966), Barner et al (1976), Scheck (1974) and Garden (1974). Comminution in posterior cortex of neck existed with or without interposition of capsule. Comminution of posterior cortex of neck is established finding in intracapsular fracture neck femur. The exposure from posterior surface of hip again permitted bone grafting

which is widely recommended in comminuted fractures, irrespective of site, duration of fracture, bone involved and age of patient. The horizontal interposition of cortical fragment at fracture site is again a known cause of delayed union. Exposure of fracture site enabled us to remove or reduce this cortical fragment.

The posterior capsulotomy did not appreciably hampered the vascularity at the fractured site, as revealed by the fact that there is no appreciable bleeding after capsulotomy. Similar observations were made by Baksi (1986).

Thirty percent of our cases had sclerosis at fracture ends, two-third of whom had absorption of neck as well. Sclerosis of fracture ends and absorption of neck are established finding in old neglected fracture neck femur and has been reported by several workers such as Boyd, Frangakis, Marc, Meyers and Baksi.

Open reduction by posterior approach permitted the freshening of sclerosed surfaces and multiple drilling of femoral head through fractured surface which decompressed the necrotic bone and encourage the growth of granulation tissue, so vital for fracture healing. Our these observations are in accordance with that of Baksi (1986). In our study, the interposition of capsule (70%), comminution of posterior cortex (50%), sclerosis (30%), absorption of neck (20%) were the important per-operative finding. Avascular necrosis of

femoral head was not seen per-operatively in any case because these patients were screened before surgery and were treated by hemiarthroplasty. The cases which had sclerosed fracture surfaces, the fractured surfaces were freshened and reduction was achieved under direct vision.

The position of first (central) guide wire was confirmed by direct vision through the fractured surface of distal fragment. Fracture was reduced under direct vision by manipulating the foot. Then central guide wire was advanced further into head upto pre-calculated length, considering the position of Ist guide wire, the three other guide wires were placed using diamond guide and the fracture was fixed by three cannulated cancellous screws.

Inspite of meticulous care good reduction could be achieved only in 70% cases. Posterior comminution, absorption of neck, small proximal fragment and anatomical architecture of this area are main obstacles to achieve good reduction. Difficulty in achieving the anatomical reduction has also been observed by Frangakis (1966), Barnes (1976) and Scheck (1979).

Coxa valga upto 20^{o} was considered to be acceptable position and satisfactory reduction. Extreme valgus or varus reduction was not accepted, as also reported by Bunata et al (1959), Garden (1966). They were also against the severe valgus reduction, which increases the risk of avascular

necrosis and non-union. The Garden's angle less than 160° denotes unstable varus reduction and angle more than 180° denote severe valgus reduction.

Frangakis (1966) also stressed upon the accuracy of reduction and considered an angle of 165° as normal relation in head and neck in this plane. Any reduction above this angle was considered as imperfect reduction. He also observed that fixation, in more than 20° valgus has catastrophic effect on the viability and union of the head. Similar findings were observed in our study as one case in whom the good reduction could not be achieved, the fixation was lost in the post-operative period and the case ultimately landed into non-union and has poor results (It is not possible to comment on viability of head as follow-up period was short).

Deyerle (1965) on the contrary, recommended valgus reduction because it shorten the neck and decreases the amount of motion at fracture site. Barnes et al (1976) reported the higher incidence of late segmental collapse when the fracture was fixed with Garden's angle more than 180°. Frangakis (1966) on the other hand said that rotation in horizontal plane has no significant effect on avascular necrosis of femoral head.

Inspite of meticulous fixation (as seen in post-operative X-rays), the secured fixation could be achieved

in 90% of cases. Remaining one case had lost fixation due to poor reduction. Retention of reduction obtained by internal fixation though was not difficult but rotation of femoral head with striking of first guide wire and occasionally of second guide wire posed some problem specially when proximal fragment was short. Introduction of subsequent guide wires did not cause any rotation of femoral head, thus temporary fixation by multiple guide wires provide sufficient fixation to drill the fragment and rigid internal fixation with multiple cannulated cancellous screws, which is a pre-requisite for union of fracture.

Rehnburg & Claes Olerud (1987) used cancellous cannulated self tapping screws for fixation of fracture neck femur. They achieved 100% union rate and no case reported for loosening of screws. Gupta et al also used A.O. multiple cancellous screws for fixation of fracture neck femur and reported better results than multiple pins fixation in contrast to report of Deyerle (1986). Screw fixation takes smaller area of neck femur, causes less damage to vascular supply of femoral head as compared to triflanged nail as reported by Rehnburg (1987).

We used cancellous bone graft obtained from greater trochanter to pack the gap between head and neck or at site of comminution. We always got enough cancellous bone graft from greater trochanter to fill the gap. The

advantages of taking the graft from greater trochanter are - it could be removed by same incision, from same operative field, did not cause much bleeding, did not add to the operative time, and at the same time provide good quality of cancellous bone. Baksi (1986) has also used the cancellous bone graft from greater trochanter and reported good results.

Complications of the procedure were few in the form of superficial infection 20%, deep infection 10% and loss of fixation 20%. Bending or breaking of screws did not occur in any case of our study. Fixation by screws is better than pin fixation. Baksi (1986) reported bending, breaking and extrusion of pins in 16% of cases and attributed them to premature weight bearing.

The collapse of femoral head was not noticed in any case due to short follow-up. Baksi (1986) reported late segmental collapse in 2 out of 56 cases treated by this technique, which was detected 18-22 months after the operation. Scheck (1967) believed that open reduction is usually associated with higher incidence of non-union, possibly because of interference with retinacular vessels. However, the present study and that of Baksi (1986) shows lower rate of non-union and avascular necrosis of femoral head, probably due to muscle pedicle bone graft.

Limb length discrepancy which could occur due to malreduction, absorption of neck or collapse of femoral head was noticed in two cases of this series. In one of whom it was due to valgus reduction, loss of fixation and non-union. Other had marked absorption of neck and 1 cm shortening which was left over, did not affected results at all as limb length discrepancy of two (2) cm can be compensated by pelvis tilt as also reported by H. Willium, Barnes, Mayers and Baksi.

Good reduction and rigid internal fixation by multiple cannulated screws permitted early physiotherapy. Our majority of cases could be out of bed after 6 weeks with crutches. Majority of our cases were able to sit cross-legged & squat within the period of 12 to 24 weeks after the surgery. We permitted gradual weight bearing on fractured hip after 6 weeks of operation. Full weight bearing, however, was not permitted before roentgenographic consolidation of fracture. Early weight bearing was not possible where there was marked absorption of neck or reduction and fixation was not proper. Garden, Meyers, Baksi & Gupta also recommended graduated weight bearing according to fixation & reduction achieved. But Willium Arnold (1984) concluded that early weight bearing is beneficial than the late weight bearing even in those cases who had poor fixation but good reduction.

Fresh fracture with good reduction and rigid internal fixation got consolidated within 12 weeks after surgery. The cases operated within 12-18 weeks of injury took 13-18 weeks to unite. Thus observations suggest that early fixation with muscle pedicle provide early consolidation and good functional hip thereby good to excellent results. Those cases were having marked absorption of neck and sclerosis of fracture surfaces took longer time to unite and average functional results. It is also reported by Price, Garden, Bunata, Meyers and Baksi.

The results are evaluated on the basis of Larson criteria given in 1963, which is based on scoring system. The function of hip joint and freedom of pain were given 35 points each; gait, absence of deformity and full range of movements were given 10 points each.

The patients who scored 90 and above were graded as excellent results, score 80-89 were graded as good, scores 70-79 were graded as fair and less than 70 were graded as poor results.

Fifty percent of our patients had good functional results - no pain or minimal pain, normal gait, free from deformity and score between 80-89 points hence, were graded as good results. Unfortunately, none of our patients of this study could be graded as excellent because none of them could score full points, either they had negligible

pain on walking or restriction of terminal degrees of movements or needed stick to walk. Two (20%) of our patients scored between 70-79 points and hence could be graded as fair results. Inability to score higher was due to valgus reduction in one patient leading to limb lengthening and restriction of terminal degree of movements, which interfered with function and cause pain on full weight bearing. Other patients had shortening instead of valgus reduction. The shortening was due to pre-operative marked absorption of neck, which could be reconstructed partially only.

Three of our patients scored less than 70 points and hence were graded as poor results. One of whom had deep seated infection and hence required debridement and excision of head, leading to limping, inability to bear full weight and psychological problem. The other patient was doing very well upto 2 months of post-operative period but did not followed the instructions, went ahead with full weight bearing leading to loss of fixation and hence poor scoring. Third patient of this group who had poor result was due to osteoporosis leading to poor fixation per-operatively and loss of fixation subsequently.

We observed that good reduction, rigid fixation and guarded weight-bearing as per advice, are essential to achieve excellent to good results. Good reduction and rigid internal fixation as a pre-requisite to union had also

been reported by other workers such as Price, Garden, Meyers, Baksi and Gupta et al.

A published study at Los Angeles County, University of Southern California Medical Centre, reported 35% of non-union in study of 250 cases before introduction of muscle pedicle bone grafting technique. With the advent of muscle pedicle bone grafting and fixation by multiple cancellous screws, the rate of union was remarkably high i.e. upto 95%.

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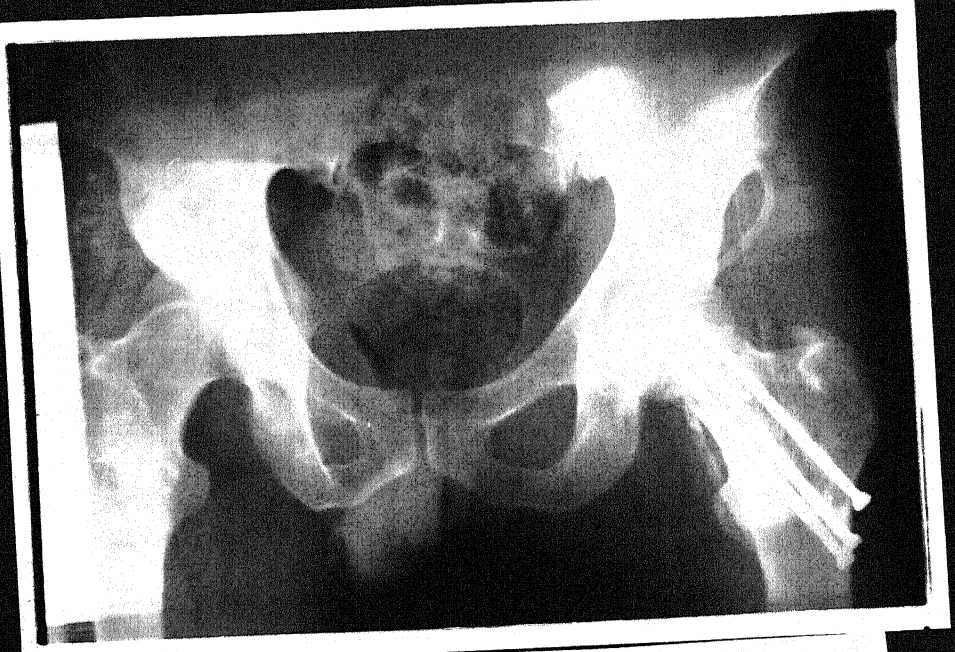
23. Case No.2 Preoperative X-rays

24. X-ray pelvis with both hip- A.P. view

31. X-ray Rt. hip- lat view

26. Case No.2 post operative X-rays



27. X-ray pelvis with both hip A.P. view

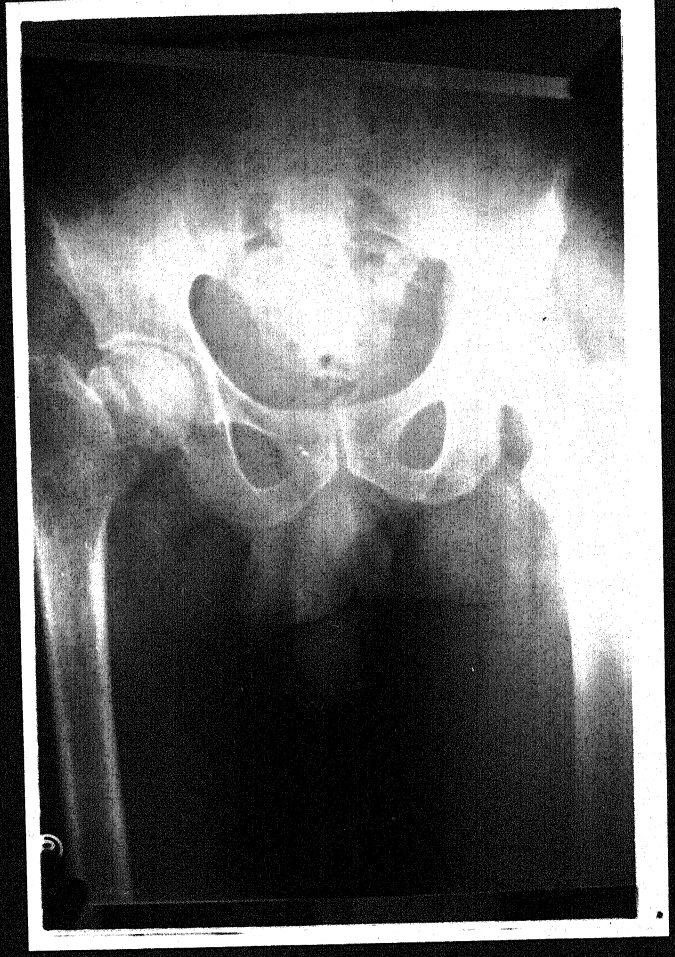
28. X-ray ~~Lt.~~ hip -lat view

29. Case No.2 X-rays 6 months after surgery

30. X-ray pelvis with both hip A.P. view

17. X-ray Rt hip lat view

Case No.3 Preoperative X-rays



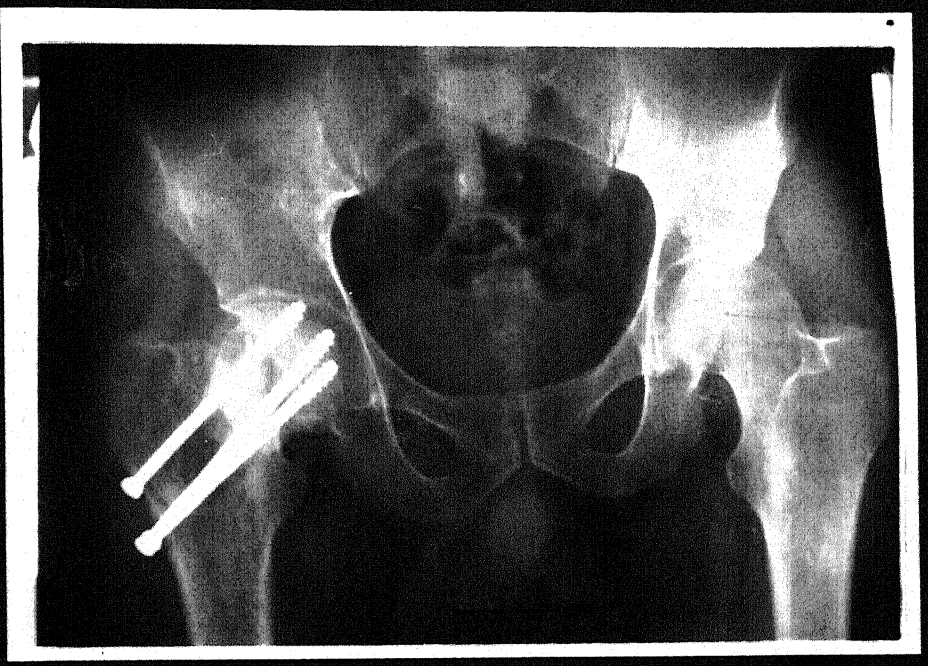
36. X-ray pelvis with both hip
A.P. View

34. X-ray Rt. hip- lat view

35. Case No.3 post operative X-rays

37. X-ray Rt. hip-lat view

3 X-rays 6 months after surgery



39. X-ray pelvis with both hip A.P.

CONCLUSIONS

CONCLUSIONS

Ten cases of femoral neck fracture both fresh as well as neglected or ununited were treated by open reduction and internal fixation with multiple cannulated cancellous screws with muscle pedicle bone grafting. Following conclusions were drawn.

1. Open reduction provide an opportunity of direct visualization of fracture site.

2. Soft tissue interposition in form of capsule can be removed which is otherwise not possible by close reduction. The soft tissue interposition and posterior comminution are important contributing factors for non-union.

3. Open reduction also provides an opportunity to freshen the fracture surfaces and decompression of necrotic bone which encourages the growth of vascular grannulation tissue, so, useful for union. Open reduction provide an opportunity to treat this fracture as fracture elsewhere in the body.

4. Posterior capsulotomy does not appreciably hamper the blood supply of femoral head.

5. Accuracy of reduction of fracture can be viewed directly.

6. Multiple cannulated screws provide rigid internal fixation. Primary fixation by guide wires minimises the chances of loss of reduction during fixation.

7. The direct visualization of first guide wire through the fractured surfaces and then its advancement makes use of image intensifier or X-ray optional.

8. Inlay muscle pedicle bone graft increases the vascularity, acts as strut across the posterior cortical defect, prevent posterior tilt of femoral head, thus encourages the revascularization and osteosynthesis of femoral head.

9. The rate of union is higher in cases treated by open reduction, internal fixation by multiple cannulated cancellous screws with muscle pedicle bone grafting as compared with other method of treatment.

10. Rate of avascular necrosis and segmental collapse are reduced.

11. The natural femoral head is retained, which provide better quality of hip joint function.

12. The complication of internal fixation by cannulated screws are few as compared to fixation by other devices.

13. Higher rate of union can be achieved in old fracture. If this procedure fails, the local anatomy is not disturbed. So hemiarthroplasty or total hip replacement can still be performed.

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